Insect Management introduction

Biological_control_introduction_final

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1. Entomology
2. Pests

- DOES the concept of the PESTS and BENEFICIALS exists in NATURE

NO

- PEST is an ANTHROPOCENTRIC concept, related to the HUMAN BEINGS (man)
- WHAT DOES EXIST in NATURE
- TROPHIC LEVELS, PYRAMIDES, CHAINS, NETS

WHAT DOES EXIST in NATURE

1. NATURAL ENNEMIES of INSECTS: Organisms that can reduce the population density of them
2. EFFECTIVE NATURAL ENNEMIES of INSECTS: Organisms that can reduce the population density of them at an economical threshold (economical injury level)
3. The insects in natural ecosystems are not distinguished in PESTS and BENEFICIALS

The following terms are related to MAN

1. Pests
2. Crop Protection & Pest Control
3. Needs for Crop Protection?
4. Methods, (Techniques)
5. Strategies of Crop Protection & Pest Control
6. Advadages and Disadvadges of Strategies
7. Current Status of Crop Protection
8. Needs for efficient and sustainable methods of CP
9. Modern crop protection is applied ecology
10. Biological Control

Pests

The term pest is anthropocentric:

- In ecological sense, there are no pests
- In absence of humans and their activities, all organisms are just part of an ecosystem

Pests originate in the context of human activities and objectives

- A species is not a specific pest
- E.g., a spider is a pest for a homeowner, but beneficial for a specialist in biological insect control.

A working definition of Pest

- In the context of crop protection, pests are all organisms within the cropping environment that cause injury to the crop and are capable of reducing yield and/or quality
- Includes insects, weeds, plant pathogens, birds, non-human mammals
- and other organisms which pose non-medical problems to humans and non-veterinary problems to animals

A pest must cause injury

In order for an organism to be considered a pest, a damaging stage of the organism must be present in high enough numbers to cause actual injury to something valued by people.

Pest

according to Federal Insecticide Fungicide and Rodenticide Act (FIFRA)

Pest can be

Any organism which interferes with activities and desires of humans

Pest

1. Pathogens-
2. Weeds-
3. Nematodes-
4. Roundworms
5. Molluscs-slugs snails•
6. Arthropods-insects , mites, crustaceans,
7. other joint legged invertebrates•
8. Vertebrates-birds, mammals, reptiles, amphibians

Major Groups of Arthropod Pests

- Scales & Mealybugs
- Aphids & Whiteflies
- Spider Mites
- Borers & Beetles
- Caterpillars & Thrips

Scales & Mealybugs

Scales & Mealybugs

- Host Range: Most generalists some specialists
- Sampling Methods: Visual inspection; look for crawlers every 7-10 days

Settled crawler of lobate lac scale

Lobate lac scale

Long-tailed mealybug

Aphids & Whiteflies

Aphids

- Damage: tips, leaves; watch for detectable sooty mold
- Sampling Methods: visual inspection 1-2x Per week
- Potential vector for disease

Green peach aphid
Wingless and winged forms

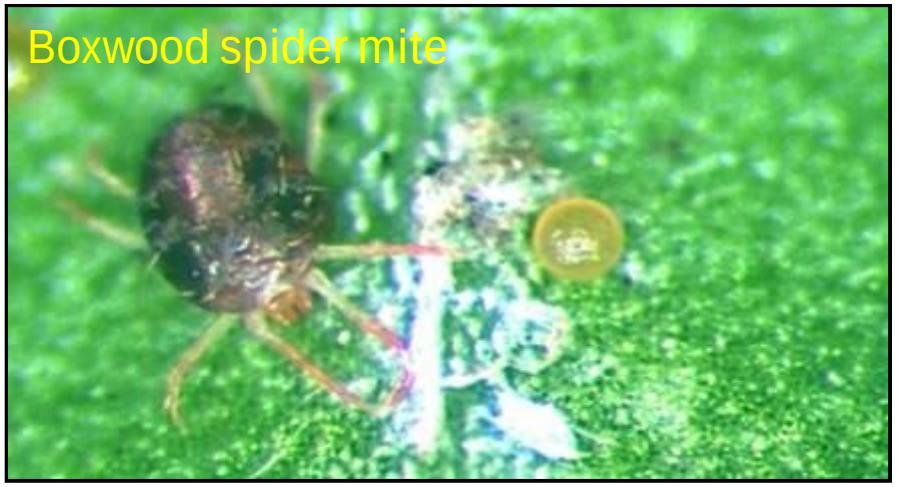
Whiteflies

- Host Range: some specialists, several generalists
- Sampling Methods: visual inspection every 7-10 days
- Potential vector for disease

Spider Mites

Spider Mites

- Damage: leaf chlorosis, defoliation
- Host Range: some specialists, several generalists
- Sampling Methods: tap leaves on paper 1-2x per week



Beetles & Borers

Borers

- ‘Bore’ into host trunk, stem, twig or root during life cycle
- Sampling Method: inspect trunk/branches for damage

Beetles

- Damage: foliage, fruit, roots; some wood-boring species
- Host Range: some generalists and specialists
- Sampling Method: inspect host and associated damage

Caterpillars & Thrips

Caterpillars

- Damage: foliage, stems, flowers, fruits
- Host Range: some generalists and specialists
- Sampling Methods: visually look for caterpillars associated with damage

Thrips

- Damage: foliage, flowers,fruits
- Sampling Methods: inspect foliage, flowers; tap flower heads; yellow and blue sticky traps
- Potential disease vector

Pest Status

Status of an organism as a pest within an agroecosystem is not fixed (e.g. the same species may be injurious, or of no importance)

Status of pest is determined by several factors such as

- Pest
- Time
- Crop
- Environment

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8. IPM, a new crop protection paradigm

Crop Protection & Pest Control

- Crop Protection: The entire range of measures to prevent or minimize damage and yield reduction of useful plants (e.g. crops) by using all relevant scientific knowledge in an ecological and economically suitable way
- Pest control: The regulation or management of another species defined as a pest, usually because it is believed to be detrimental to a person's health, the ecology or the economy.

Crop Protection:
A human war for survival

Needs of food for survival is a common thread that unites humanity

1. Every slice of bread that is buttered
2. Every potato that is boiled
3. Every cup of coffee that is consumed, etc..

In order To feed and meet the needs of an ever growing human, crop productivity has to be increased

This is a conclusion of another battle in the war that has started since the invention of agriculture, and that we will be fighting upon the day we become extinct

Crop Protection:
A human war for survival

1. Crop Protection is the war of man against **an upset balance** in his environment;
2. man is directly responsible for upsetting this balance
3. and he is constantly striving to put is right through crop protection

Needs for Crop Protection?

- CP (Crop protection) & PC (Pest Control) are at least as old as agriculture. In order to maximize food production, it can be economically advantageous to protect crops from competing

1. other species of plants (weeds) and
2. other herbivores competing with humans, that we conveniently called pests

Needs for Crop Protection?

But we have to do this in a sustainable way

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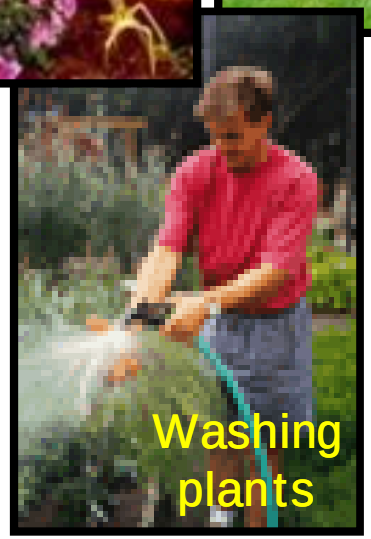
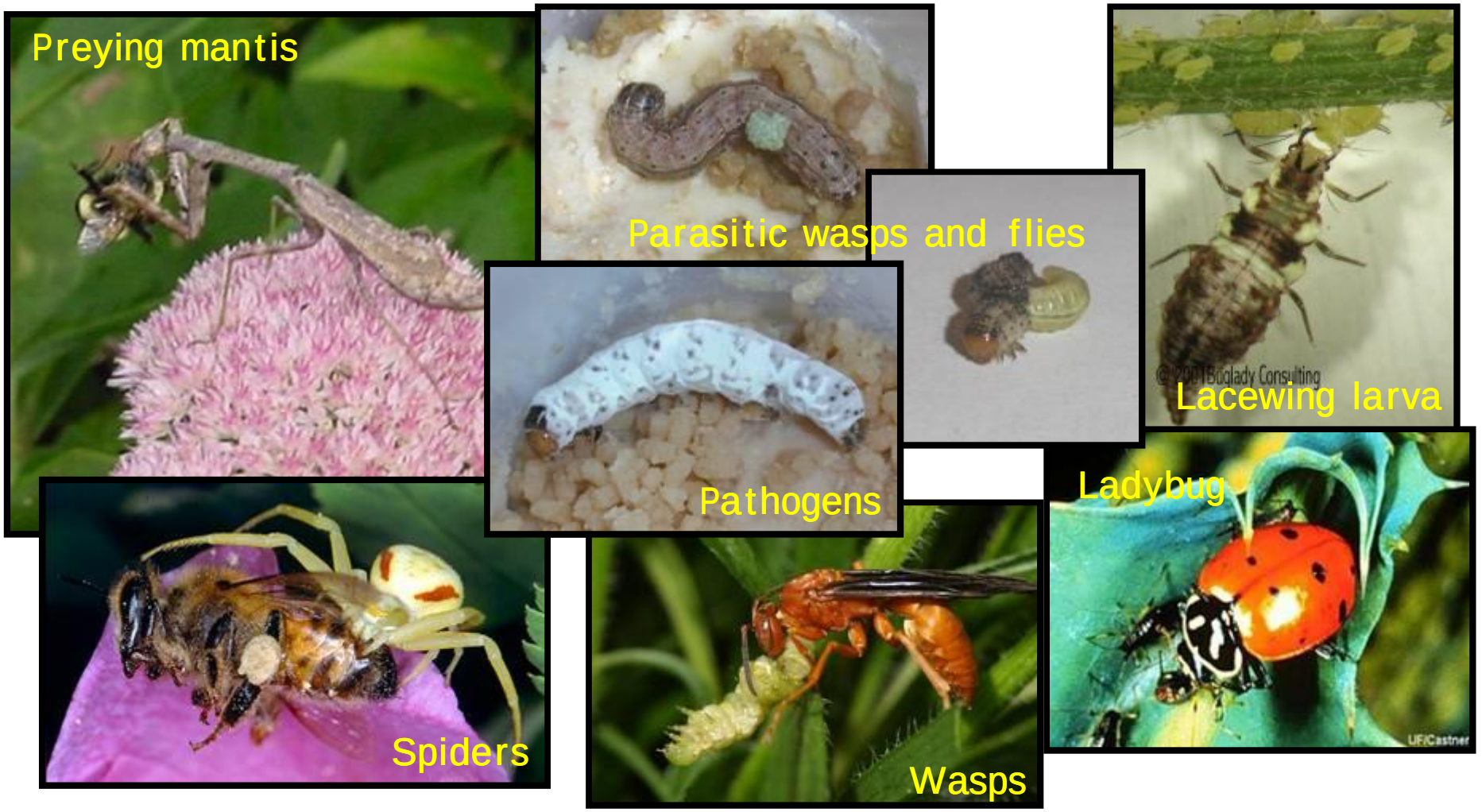
Mechanical/Physical Control

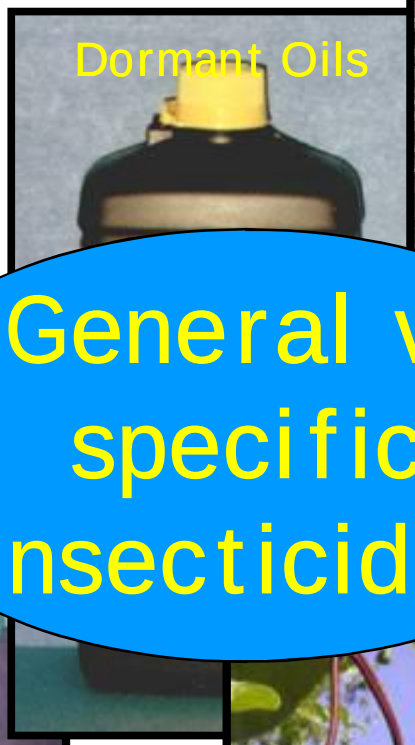
Cultural Control



Biological Control

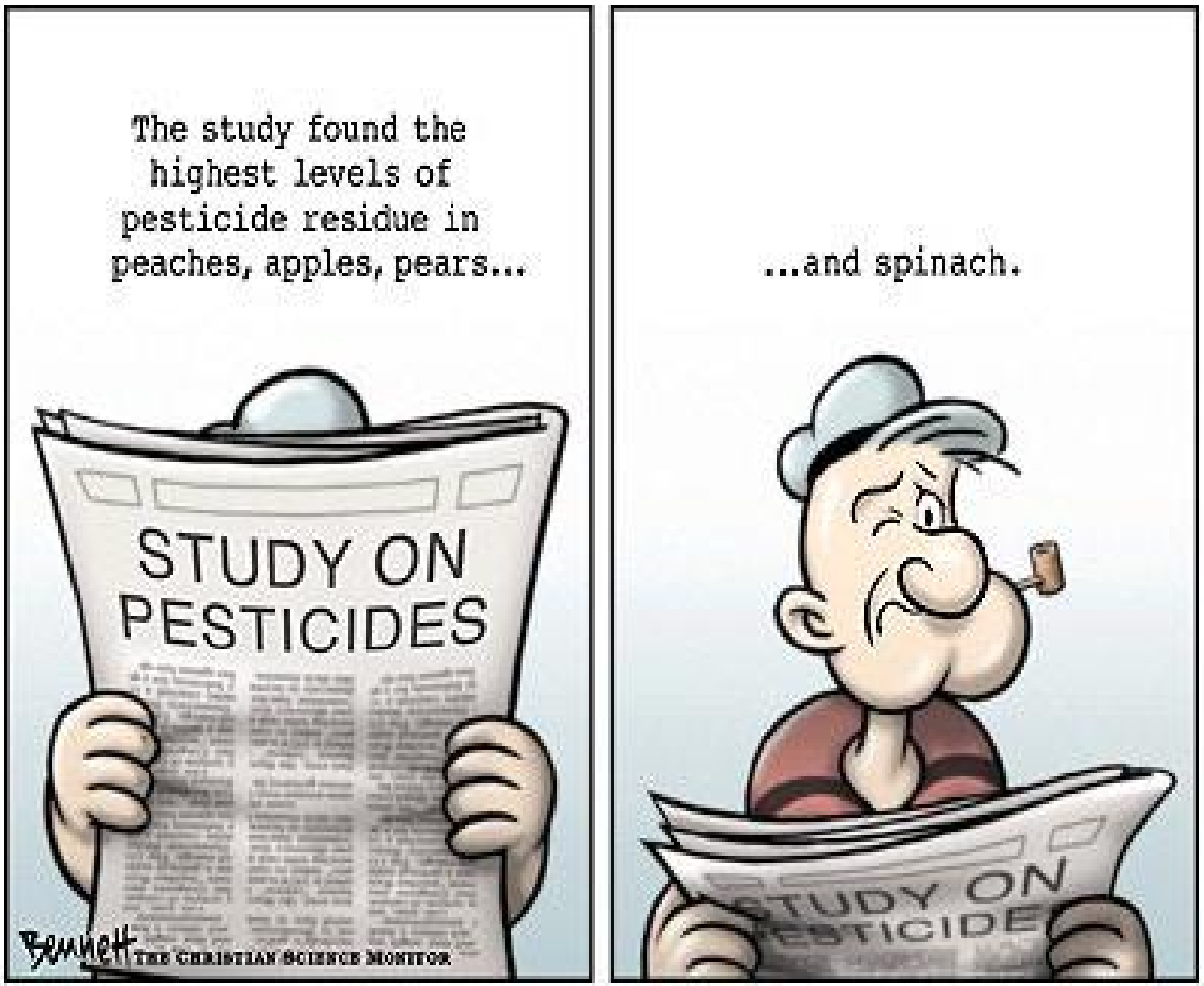


Chemical Control



General vs specific insecticides

Chemical control

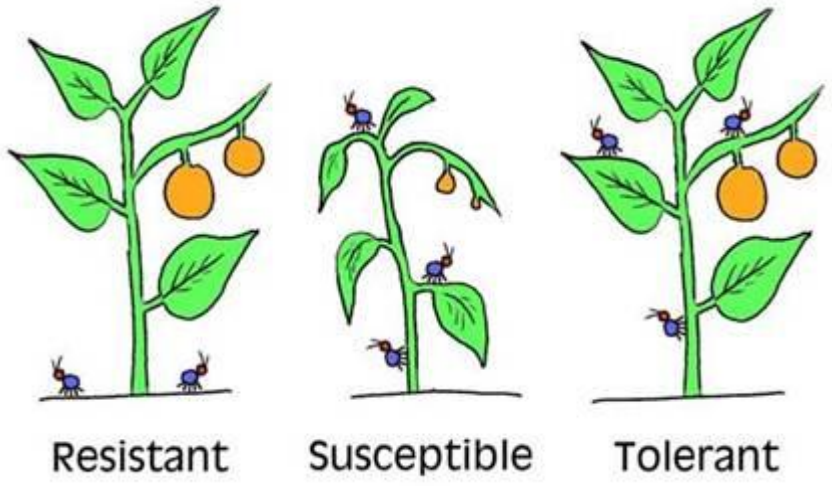


- Should be used as a last resort and with the lowest impact on natural enemies and YOU!

Variety Selection

Three ways plants are resistant

- Tolerance
  - Plants able to withstand injury better
- Antixenosis
  - Not-preferred
    - Too hairy, too waxy
    - Odorous



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Strategies of Crop Management

and Crop Protection

1. Conventional
2. Integrated Crop Management (ICM)
3. Organic Farming Agriculture

Conventional

Normally It uses

1. chemical synthetic fertilizers
2. chemical synthetic pesticides
3. Hormones
4. No Economic Thresholds are used
5. It is very intensive

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ICM

Integrated Crop Management (ICM)

The Crop System which uses all the alternative methods in an integrated way avoiding the use of

1. chemical synthetic fertilizers
2. chemical synthetic pesticides
3. Hormones
4. It is not very intensive
5. The most important component of ICM is the IPM

IPM

Integrated Pest Management

Give a definition

Integrated Pest Management (IPM) is

the coordinated use of pest and environmental information with available pest control methods

to prevent unacceptable levels of pest damage

by the most economical means and

with the least possible hazard to people, property, and the environment.

Integrated Pest Management (IPM)

- Management of pests that incorporates many practices for environmentally friendly and economically feasible control of pests
  - Physical/Mechanical – barriers, hand removal
  - Cultural – proper irrigation
  - Biological – ladybugs, lacewings, etc.
  - Chemical –selective vs general insecticides
  - Variety selection – tolerance or resistance

What IPM is NOT!

- **IPM does NOT prohibit the use of pesticides!**
- **IPM is NOT merely a biological or "organic" pest control program**
- **IPM is a decision-making process, and NOT a stringent or rigid management regime**

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Advadage and Disadvadges of Strategies Conventional

Advadage and Disadvadges of Strategies

IPM

Advantage and Disadvantages of Strategies

Organic Agriculture

Which is NOT SUSTAINABLE
(Why???)

Which is more Sustainable (Why???)

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Current Status of Crop Protection????

1. IPM is widely recognized as the proper approach to dealing with pests in production agriculture.
2. Implementation is up to individual farmers so it varies considerably
3. Concepts are well established but the technology continues to improve.

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Why???????

Needs for efficient and sustainable methods of CP

Sustainable agriculture integrates 3 main goals:

1. Environmental Health
2. Economic Profitability
3. Social and Economic Equity

Needs for efficient and sustainable methods of CP

Sustainable agriculture rests on the principle

That

we must meet the needs of the present

without

compromising the ability of future generations to meet their own needs

we must meet the needs of the present

without compromising the ability of future generations to meet their own needs

How do we achieve this?

Sustainable crop protection is applied ecology

Agroecosystem must be understood at different levels of resolutions,

understanding

1. the crop,
2. the pests,
3. the environment, and
4. the management activities

is key for successful crop protection

Needs for efficient and
sustainable methods of CP

TO GO TO THIS CONCEPT

THERE IS A NEED TO ……

Know the Difference

- It is critical to know the difference between beneficial insects and harmful pests

Pest – southern green stink bug

Beneficial – a predatory stink bug

Some are *PESTS*

- **People pests**

  Mosquitoes, fire ants, venomous spiders and hornets can injure and annoy people

- **Plant pests**

  Other insects threaten plants including plants that humans depend on for food

Black Widow Spider

Wheat Aphid

Some are Beneficial to Man

- One way to think about bugs is to divide them into “beneficial” and “harmful” categories.
- Not every member of the arthropod phylum is a biting, blood-sucking horror.
- Indeed, many bugs are beneficial.

1. Honeybees pollinate.
2. Ladybugs eat aphids, scale and mites.
3. Night crawlers are powerful ultimate soil engineers.
4. Crickets are edible: 100 grams contain 121 calories and 13 grams of protein.

Some are Beneficial to Man

- Beneficial
  1. Honeybees and wild bees
  2. Ladybug (larvae)
  3. Praying mantis
  4. Ambush bugs
  5. Common lacewing
  6. (larvae)
  7. Ground beetle
  8. Robber flies
  9. Predatory thrips
  10. Tachinid flies

- Beneficial Activities
  1. Decomposers/recyclers
  2. Pollinators
  3. Pest controllers
  4. Food sources for other animals (or humans)
  5. Products for humans
  6. Medical research
  7. Soil engineers

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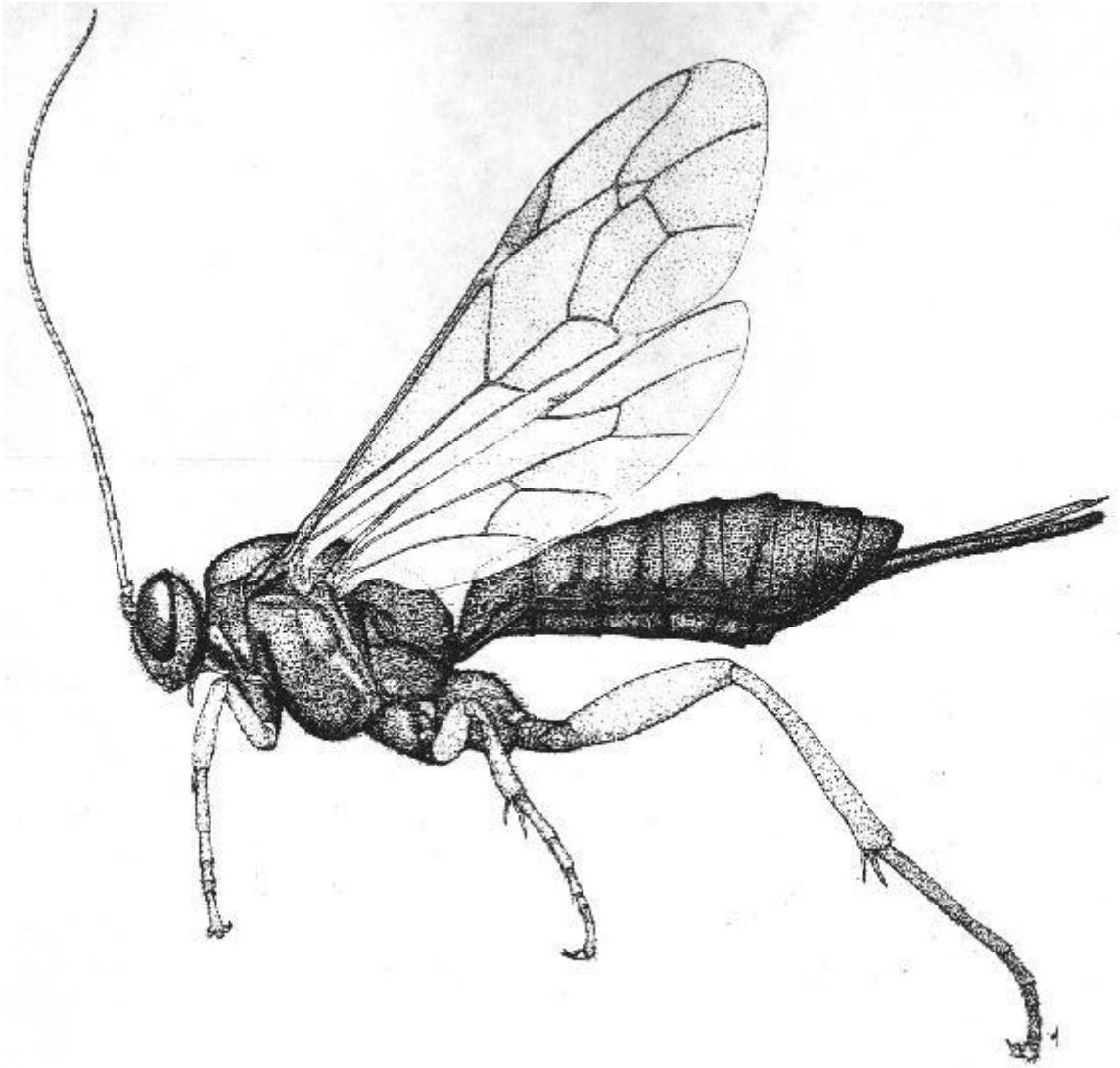
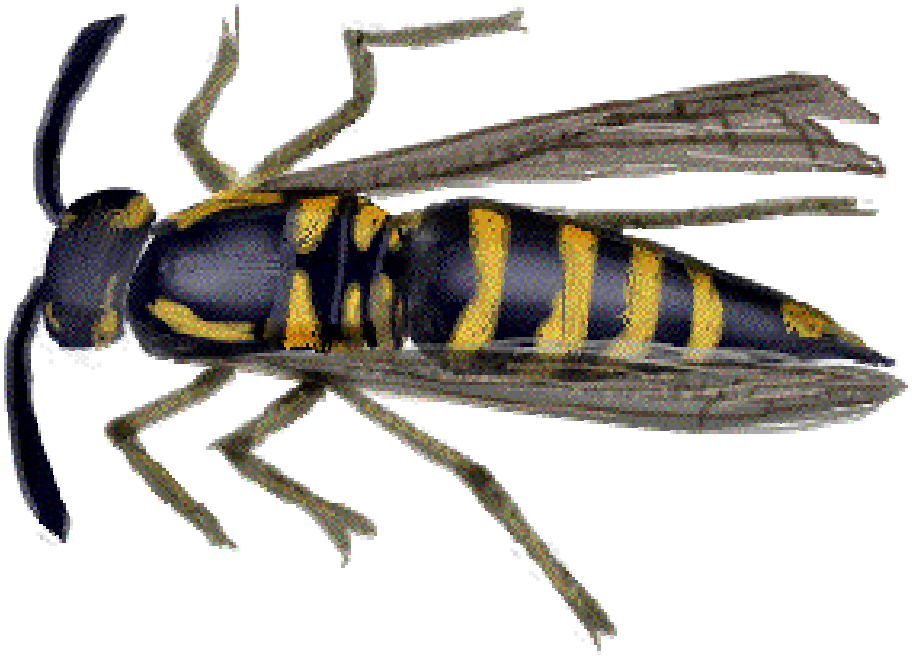
Autoecological research on pests and natural enemies



What is Autoecology?

- It is the study of the biology of particular species and their interactions with their environment. Often referred as natural history.



The natural history of Natural enemies (autoecology) in general is unknown to us.

Predators are not better off than parasitoids when it comes to how much we know about them. Actually we know much more about parasitoids than we do know about predators. This is because parasitoids are used more than predators in bio-control.

In this slide you can see a tiger beetle (**a predator)** about to feed on a wasp (**another predator**).

This is called intraguild predation.

Is intraguild predation a desirable or undesirable event in biocontrol?

What do you think?.

try to answer the question……

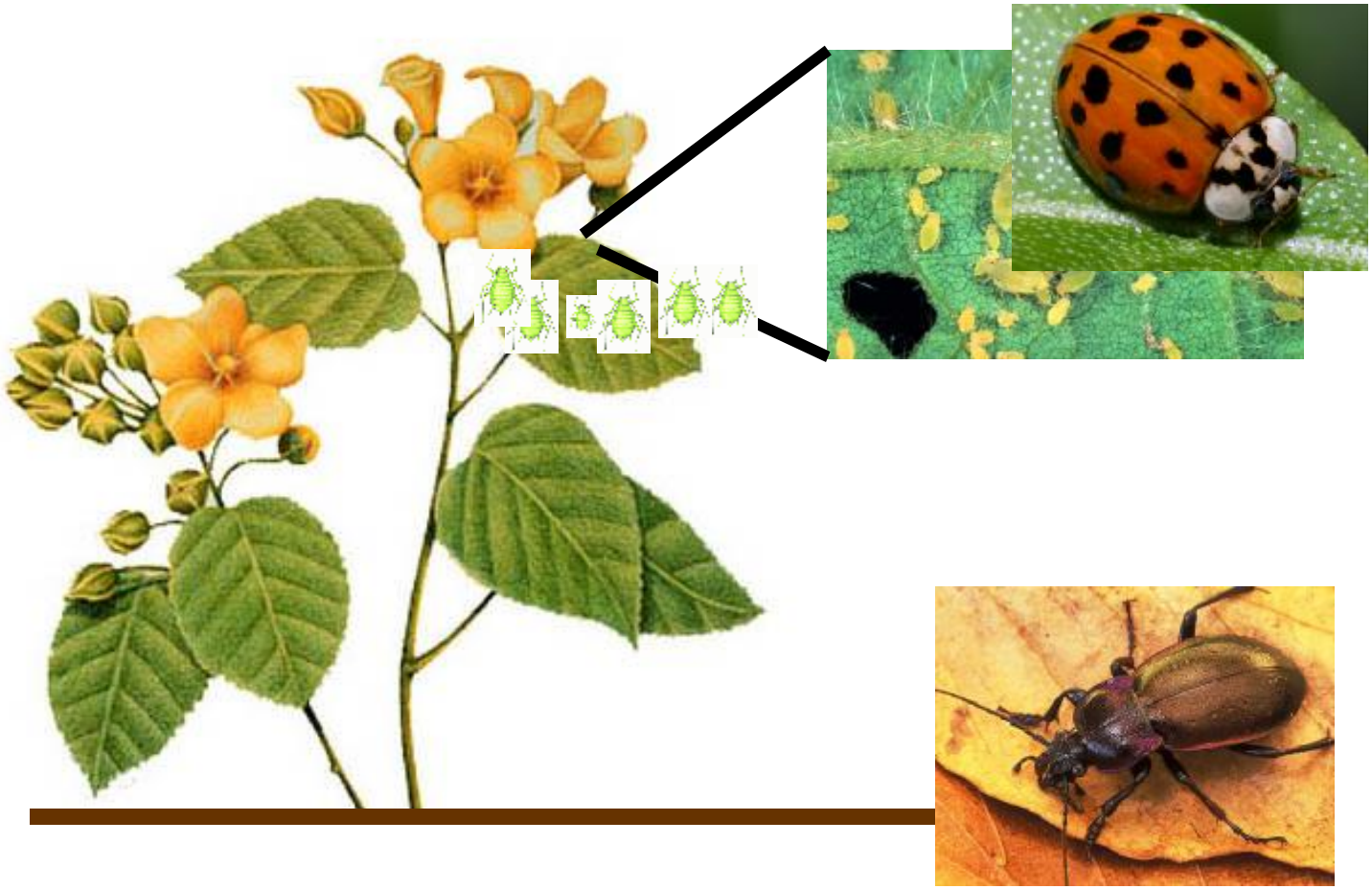
JUSTIFY YOUR ANSWER

The answer is,

- that intraguild predation is an undesirable event
- because it will diminish the efficiency of your control strategy.
- We do not want two predators eating each other.
- We want them to feed on the prey.

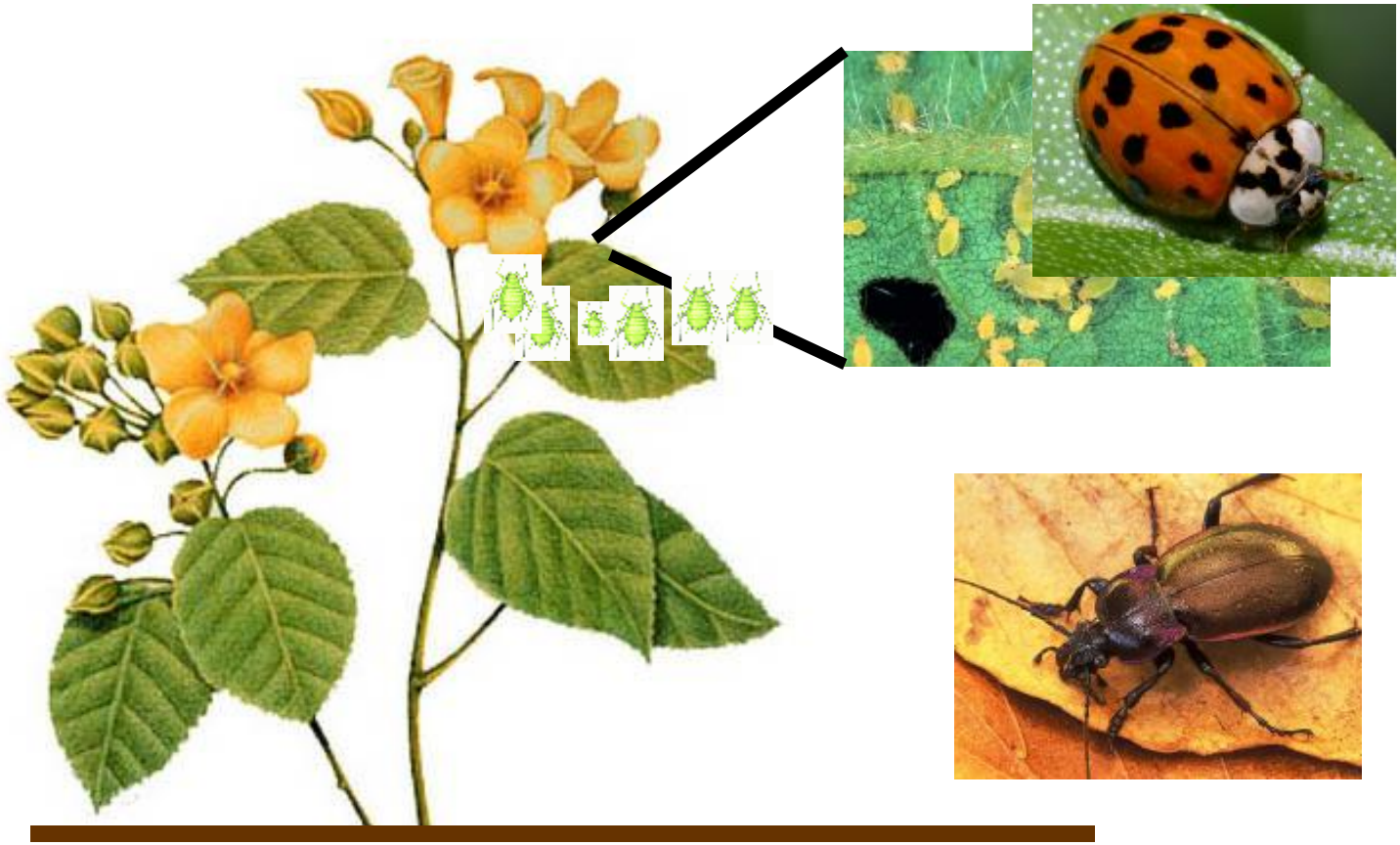
- When predators eat each other we say in IPM
- that they “interfere” with each other.
- We do not want that.
- We want them to be synergistic with each other.
- That is, we want them to cooperate with each other when consuming on a prey.
- Is this intraguild predation event common or not? We don’t really know.

Synergistic Interaction



TRY to DESCRIBE and EXPLAIN the PICTURE

Synergistic Interaction



This is an example of a synergistic interaction between two predators. Both of them eat aphids (the pest). But they eat them on different places. The lady beetle eats aphids on the leaves. The presence of the beetle make aphids drop to the grounds (a response to an alarm pheromone they use). On the ground aphids will be eaten by a ground beetle. This is an example of a very efficient synergistic or cooperative interaction between two natural enemies.

Ecological interactions among biological species have been simplified to hypothetical equilibriums.

These theoretical abstractions and simplifications of the biology of the species involved in biocontrol ***is behind several of the failures in this practice.***

We need to try to make models much more realistic.

The only way to do that is knowing our species biology well and increasing the amount of knowledge we have of statistics and math.

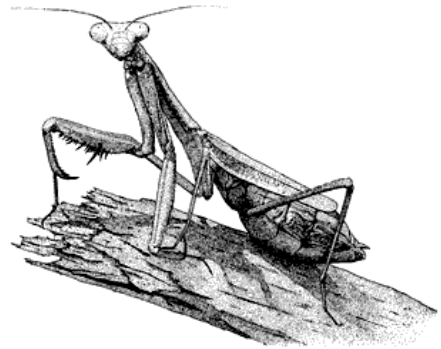
If we don't want to do the realistic models

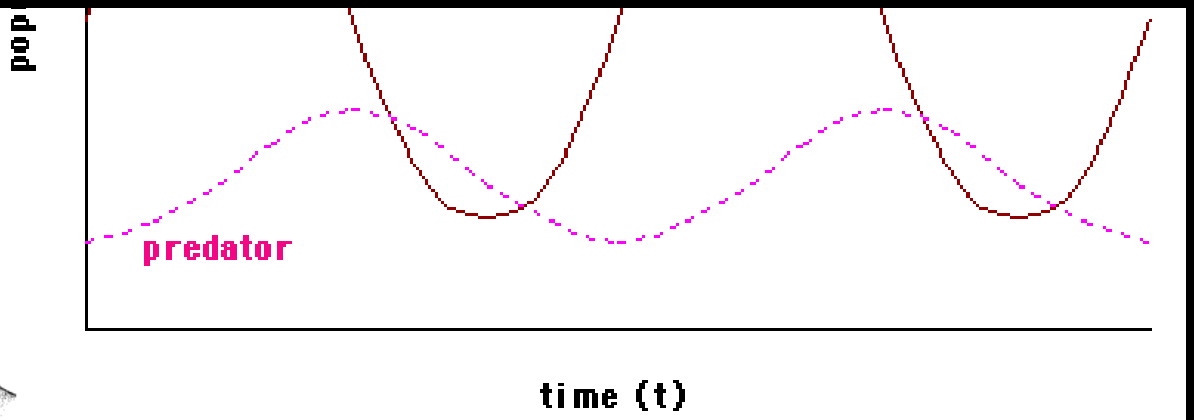
IPM researchers should at least being able to communicate

with mathematicians and statisticians

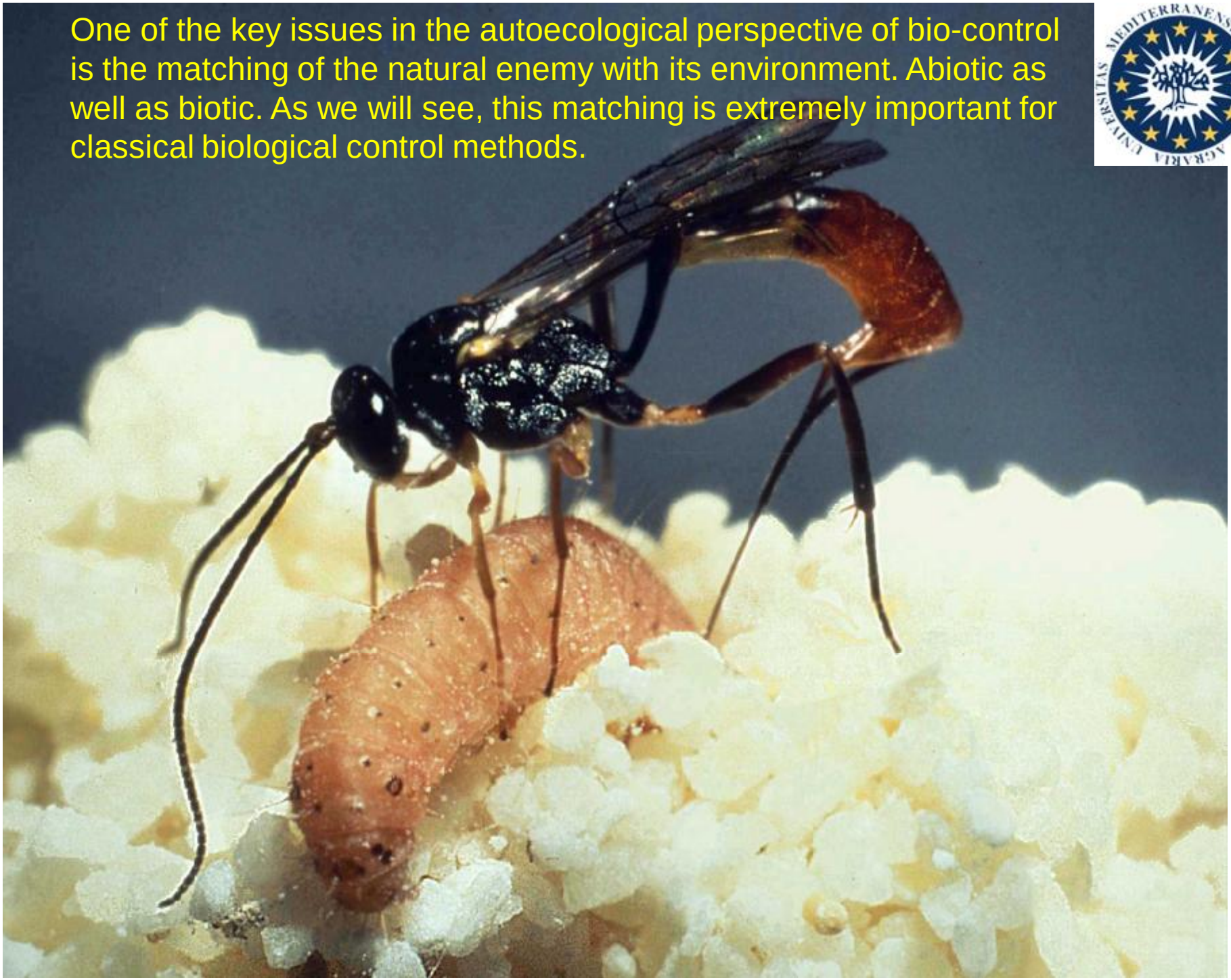
so we can tell them what to develop for us.

So lets take some stat classes

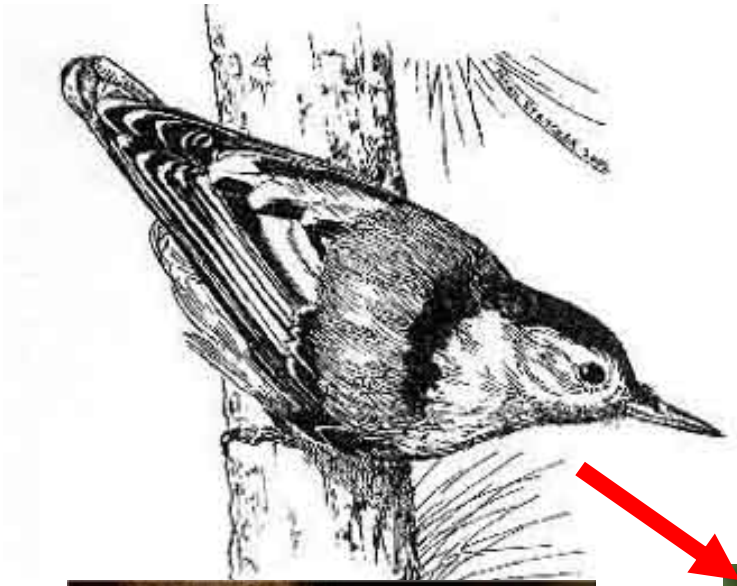




One of the key issues in the autoecological perspective of bio-control is the matching of the natural enemy with its environment. Abiotic as well as biotic. As we will see, this matching is extremely important for classical biological control methods.



- It is also very important to realize that pests and their natural enemies co-exist with several organisms at the same time.
- We usually study them in pairs (i.e. predator-prey interactions, plant-insect interactions, parasitoid-host interactions, etc)
- but we need to be aware that a lot of other interactions are occurring among pests and their environment besides the ones we pick to study.

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